Claims

What is claimed is:

1. A fuel cell power plant (110) comprising:
a fuel cell stack assembly (CSA) (12) having an anode region (16) having an inlet (26) and an outlet (42), a cathode region (18) having an inlet (36) and an outlet (46), an electrolyte region (20) intermediate the anode and cathode regions, and a coolant region (22) having an inlet (48) and an outlet (50); an inlet fuel stream (24) operatively connected to the anode region inlet (26); an inlet oxidant stream (134′) operatively connected to the cathode region inlet (36); a coolant loop (114) operatively connected to the coolant region inlet (48) and outlet (50), the coolant loop (114) including a heat removal means (152, 156) for transferring heat from the CSA coolant at a source temperature to a sink medium at a sink temperature lower than the source temperature, the difference between said source temperature and said sink temperature being a temperature differential; and
a humidifier (70) operatively connected in the coolant loop (114) and in the inlet oxidant stream (134′) for both cooling the coolant prior to return introduction of the coolant to the CSA (12) and for relatively increasing the temperature and humidity of the inlet oxidant stream (134′) prior to introduction of the inlet oxidant stream to the CSA oxidant region inlet (36), thereby to distribute the heat of at least the CSA (12) and the heat removal means (152, 156) so as to increase the coolant exit temperature from the CSA (12) and to the heat removal means (152, 156) so as to relatively increase the temperature differential between the source temperature and the sink temperature.

2. The fuel cell power plant (110) of claim **1** wherein the humidifier (70) cools the coolant sufficiently to maintain the coolant inlet temperature to the CSA (12)

substantially constant relative to operation without the humidifier (70).

3. The fuel cell power plant (110) of claim **1** (or 2) further including a relative reduction in the size of the heat removal means (152, 156).

4. The fuel cell power plant (110) of claim **1** (and/or 3) wherein the heat removal means (152, 156) comprises a radiator (152) and motorized fan (156).

5. The fuel cell power plant (110) of claim **1** wherein the humidifier (70) comprises an energy recovery device (70) for heat and mass transfer between the inlet oxidant stream (134) and the coolant (114''') being returned from the heat removal means (152, 156) to the CSA (12).

6. The fuel cell power plant (110) of claim **5** wherein the energy recovery device (70) comprises a gas flow chamber (72) and a liquid coolant flow chamber (74) separated by a fine pore enthalpy exchange barrier (76).

7. The fuel cell power plant (110) of claim **5** wherein the energy recovery device (70) comprises a saturator having the inlet oxidant stream (134) in direct contact with the coolant (114''') being returned from the heat removal means (152, 156) to the CSA (12).

8. The fuel cell power plant (110) of claim **2** wherein the heat removal means (152, 156) is of a first capacity in the absence of said humidifier (70) and is of a second lesser capacity in the presence of said humidifier (70).

9. The fuel cell power plant (110) of claim **8** wherein the heat removal means (152, 156) comprises a radiator (152) and motorized fan (156).

10. The fuel cell power plant (110) of claim **9** wherein the humidifier (70) comprises an energy recovery device (70) for heat and mass transfer between the inlet oxidant stream (134) and the coolant (114''') being returned from the radiator (152) to the CSA (12).

11. The fuel cell power plant (110) of claim **10** wherein the energy recovery device (70) comprises a gas flow chamber (72) and a liquid coolant flow chamber (74) separated by a fine pore enthalpy exchange barrier (76).

12. In a fuel cell power plant (110) including a fuel cell stack assembly (CSA) (12) having an anode region (16) having an inlet (26) and an outlet (42), a cathode region (18) having an inlet (36) and an outlet (46), an electrolyte region (20) intermediate the anode and cathode regions, and a coolant region (22) having an inlet (48) and an outlet (50); an inlet fuel stream (24) operatively connected to the anode region inlet (26); an inlet oxidant stream (134') operatively connected to the cathode region inlet (36); and a coolant loop (114) operatively connected to the coolant region inlet (48) and outlet (50), the coolant loop (114) including a heat removal means (152, 156) for transferring heat from the CSA coolant at a source temperature to a sink medium at a sink temperature lower than the source temperature, the difference between said source temperature and said sink temperature being a temperature differential, the method of relatively increasing said temperature differential comprising the steps of:

cooling (74) the coolant in the coolant loop (114) prior to return introduction of the coolant to the CSA (12); and

relatively increasing the temperature and humidity (72) of the inlet oxidant stream (134′) prior to introduction of the inlet oxidant stream to the CSA oxidant region inlet (36), thereby to distribute the heat of at least the CSA (12) and the heat removal means (152, 156) so as to increase the coolant exit temperature from the CSA (12) and to the heat removal means (152, 156) so as to relatively increase said temperature differential between the source temperature and the sink temperature.

13. The method of claim **12** wherein the steps of cooling (74) the coolant in the coolant loop (114) prior to return introduction of the coolant to the CSA (12) and of relatively increasing the temperature and humidity (72) of the inlet oxidant stream (134′) prior to introduction of the inlet oxidant stream to the CSA oxidant region inlet (36) comprise connecting a humidifier (70) in the coolant loop (114) and in the inlet oxidant stream (134′) to perform both steps.